1,009,055

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,009,055

Date of Application and filing Complete Specification: Nov. 7, 1963.

No. 43917/63.

Application made in Canada (No. 862,117) on Nov. 12, 1962.

Complete Specification Published: Nov. 3, 1965.

Index at acceptance:—B2 B(2H, 4E1B5, 4E1BY, 4E3B, 4E5A, 4E5C, 4E6A, 4E7AY, 4E8A, 4E9Q1, 4E9Q5, 4E9Q10, 4E9QY); **F2** P(1B5D, 1B7, 3)

Int. Cl.:—B 05, B 29 d // B 31 c

COMPLETE SPECIFICATION

Pipe Coating Process

We, BANISTER CONSTRUCTION COMPANY LIMITED, a Company organized under the laws of the Province of Alberta, Canada, whose post office address is 5807—104th Street, Edmonton, Alberta, Canada, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a pipe coating method and apparatus. It is particularly directed to a method and apparatus for coating rod and tubular goods.

To prevent corrosion of rod and tubular goods such as pipe used in pipeline construction, it is necessary to provide the rod and tubular goods with a protective outer coating. Heretofore, it has been customary to coat these goods with hot enamels or a variety of tapes of various compositions. For example, hot enamel coatings consisting of a primer, enamel, inner wrap and outer wrap can be applied to the goods or the tapes applied directly to the goods or applied over a complementary primer coat.

The aforementioned corrosion protected goods are utilized on mainline pipelines, flow lines, gathering systems, distribution systems, petroleum refineries, industrial plants, pumping and compressor stations and generally throughout the petro-chemical industries as well as many specific uses wherever corrosion poses a problem to steel life.

Pipeline, rod and other tubular goods can be coated either in the field where they form an integrated component part of the structure or in stationary or yard coating plants. Heretofore, the coatings in use in the industry preferably have been applied in the field immediately prior to installation due to the fact that once applied to the end product they are relatively fragile and thus subject to damage by abrasion or impact.

There is also a great disadvantage in line travelling or in situ coating of rod, pipe and similar tubular goods after they are welded, bolted or generally fitted into place as the machinery for applying the coating is often cumbersome requiring a great deal of heavy portable equipment to facilitate the coating operation. Further, field conditions cannot be truly controlled to render operating conditions ideal for the coating application whereas in a fixed yard plant it is possible to remove all dust, dirt and other airborne debris as well as rain, snow and ice while obviating other climatic problems. It is impractical to apply many standard coatings in the field when temperatures are above 38° C. or below −23° C. or when it is raining or snowing or frost and ice have accumulated on the pipe.

We have found that the above disadvantages can be avoided and substantial advantages gained by applying protective coatings to lengths of rod, pipe and similar tubular goods in a coating plant under closely controlled operating conditions by means of the method and apparatus of the present invention. The goods are coated with a film of corrosion resistant material such as an epoxy, polyethylene, or polyester resin to form a coating having substantially all the desirable characteristics provided by conventional materials used heretofore and which, in addition, possess the added advantages of being tough, lightweight and often less expensive than said conventional materials.

A preferred method of applying a protective coating of a corrosion resistant synthetic resin such as an epoxy, polyester, or polyethylene resin to the pipe surface comprises the steps of thoroughly cleaning and heating the pipe, or at least its surface, to a temperature above the melting point of the coating material, applying the coating material in a particulate dispersed form at a temperature below its melting point to the hot pipe sur-

face such that the material will adhere thereto, melt and flow to form a uniform and continuous coating, and in the case of polyethylenes cooling the material to a temperature below its melting point such that it will cure to form a hard impermeable coating.

The coating material is preferably a quick curing corrosion resistant synthetic resin obtainable in particulate form having high dielectric properties plus resistance to moisture, acids, alkalies and heat. In addition, physical characteristics such as high adhesion strength, hardness, ductility, resilience, abrasion resistance and impact resistance are desirable to protect the pipe from damage during handling and installation. Synthetic resins such as epoxy resin powder sold under the trade name "Scotchkote", polyethylene powder sold under the trade name "Microthene" and polyesters, in the size range of from 6 to 300 microns, have been found to provide suitable coatings with substantially all of the above desirable characteristics.

It is therefore a principal object of the present invention herein envisioned to coat pipe under controlled conditions with none of the field problems of gaining access to the work and housing and feeding crews in areas that are often remote.

It is another important object of the present invention to provide a protective coating of uniform thickness free from gaps.

Another important object of the present invention is the provision of a corrosion protective coating which has high dielectric characteristics plus resistance to moisture, acids, alkalies and heat together with high adhesion strength, hardness, ductility, resilience, abrasion resistance and impact resistance for the protection of the pipe during handling and installation.

Another important object of the present invention is the provision of a process which is positive and substantially trouble-free in operation and can effectively coat rod, pipe and like tubular goods semi-automatically at a high productive level.

These and other objects of the present invention and the manner in which they can be attained will become apparent from the following description, reference being made to the accompanying drawings, in which:

Figure 1 is a plan view of a pipe coating plant employing the method and apparatus of the present invention;

Figure 2 is a perspective view of the conveying system used for conveying and imparting rotational movement to pipe while it is conveyed;

Figure 3 is a side elevation of the conveying system illustrated in Figure 2;

Figure 4 is a front elevation, partly cut away, of the holding oven;

Figure 5 is a detailed plan view, partly cut away, of the holding oven illustrated in Figure 4;

Figure 6 is a perspective view of the pipe coupler system employed to connect lengths of pipe for unsupported travel, illustrating a preferred embodiment of pipe coupler;

Figure 7 is a longitudinal section of another embodiment of a pipe coupler;

Figure 8 is a pictorial, schematic view of the coating system;

Figure 9 is a perspective view of the coating head shown generally in Figure 8;

Figure 10 is a vertical longitudinal section taken along line 10—10 of Figure 9;

Figure 11 is a vertical section taken along line 11—11 of Figure 9;

Figure 12 is a perspective view of a quenching apparatus for cooling the pipe after the coating step;

Figure 13 is a perspective view of a pipe brushing device employed as a secondary cleaning device in the present invention; and

Figure 14 is a perspective view of a pipe washing device employed as a tertiary cleaning device in the present invention.

Like reference characters refer to like parts throughout the description of the drawing.

Referring to Figure 1, the general method of the present invention described by way of illustration in relation to the coating of pipe in a central plant designated generally by the numeral 6 comprises conveying lengths of pipe 5 into a sheltered storage room by means of a plurality of conventional driven concave rollers 7 and loading said pipe onto racks 11 by means of a plurality of kickers 8 mounted equidistantly on shaft 9. Shaft 9 is rotated by a conventional pneumatic cylinder and crank arrangement, of the type illustrated in Figure 2, actuated by a limit switch 10. The forward end of pipe 5 engages switch 10 which actuates normally retracted kickers 8 pivotting them upwardly about the axis of shaft 9 to pick up pipe 5 and roll it by gravity onto racks 11. Racks 11 are sufficiently inclined from the horizontal plane to permit the pipe to roll by gravity across the rack and abut stops 11*a* in proximity to kickers 12.

Once dried and at normal room temperature, the pipe is transferred one length at a time by means of kickers 12 actuated by a torque shaft 14 and pneumatic cylinder and crank arrangement 14*a* connected thereto, as illustrated in detail with reference to Figures 2 and 3, onto concave rollers 15 and fed, at a rate of 15 metres per minute for 5.1 cm. diameter pipe, through a primary cleaning device 13 for removing surface films such as oxides, lubricating grease, oil, grit, paint and like substances to ensure adherence of the synthetic resin coating. Cleaning devices such as centrifugal blasting machines in which

abrasive particles such as steel shot are thrown at high velocity against the pipe have been found satisfactory for this purpose.

To ensure and facilitate thorough abrasive cleaning of the pipe surface, the pipe is rotated as it passes through the cleaning device by inclining the longitudinal axis of each of driven concave cast steel support rollers 15 at about 60° to the longitudinal axis of the pipe. An upper press roller 17 disposed opposite driven roller 15*a* located in proximity to primary cleaning device 13 ensures engagement of the pipe with the driven roller 15*a* such that said pipe is conveyed through the cleaning device at constant speed and with rotational movement. Each of rollers 15 and roller 15*a* is driven by a V-belt 16 or the like means as is well known in the art. In that the placement and operation of limit switches controlling and co-ordinating the transfer of pipe from rollers to storage racks and from storage racks to various stages of the present method will be obvious to a person skilled in the art to which this invention relates, the description of control switches will not be included herein.

After passing through the primary cleaning device 13, each length of pipe is passed through a secondary cleaning device 18, as illustrated in detail with reference to Figure 13, to ensure fragments of metal, oxides or the like particles adhering to the pipe are dislodged therefrom so that the coating to be applied to the pipe surface is not contaminated by foreign particles which will destroy the coating's adhesion or bonding properties. In cleaning device 18, the pipe is screwed by a series of rotating brushes 18*a* to remove any fins or raised particles on the pipe surface remaining after the primary cleaning operation. The pipe is rotated by concave rollers 15 to ensure the entire surface of the pipe is contacted by the brushes. The brushes are driven by motor 18*b* and pulley and belt system 18*c*.

The pipe is then conveyed by concave rollers 19 to storage racks 20 and loaded thereon by kickers 21 which are actuated by limit switch 10*a*. The pipe is then rolled by gravity across inclined racks 20 to kickers 21*a* which load the pipe onto concave rollers 22 which advance the pipe axially, one at a time, through a pipe cleaning device 169 comprising a spray coil 170 (see Figure 14) which pressure scours the pipe surface with a 10% phosphoric acid and detergent solution supplied by reservoir 171 to remove any minute foreign particles remaining on the pipe surface. After the acid wash the pipe passes through a standard rotating brush ring 172 which provides mechanical action to supplement the acid washing. The pipe then passes axially through a second spray coil 173 which pressure washes the pipe surface with water supplied by tubes 174 to neutralize or remove any of the preceding acid wash solution plus the loosened dirt particles and through a second standard rotating brush ring 175 to remove any loose dirt particles not washed off the pipe surface by the water spray. Brush rings 172 and 175 are rotated by motor 176 and pulley and belt system 177. After the acid and water wash, the pipe passes axially through a preheater furnace 23. The interior of furnace 23 is preferably maintained at a temperature of 1650° C. which is sufficient to heat 10.2 cm. diameter pipe, travelling therethrough at a rate of 15 metres per minute, to 120° C. We have found a 5,000,000 British Thermal Unit Furnace of the barrel type fired by propane, natural gas, infra-red radiation, induction or the like heat source to provide satisfactory preheating. To ensure the pipe is conveyed through preheater furnace 23 at a constant speed, a press roller 24 vertically disposed over a driven roller (not shown in Figure 1) positioned adjacent the inlet of cleaning device 169 interacts with driven roller 22 such that the latter positively engages the pipe for constant speed travel.

After passage through preheating furnace 23, the pipe is fed into a holding oven 25 where the pipe is heated to the desired coating temperature. As illustrated generally by Figure 1 and in more detail by Figure 4, the hot flue gases from preheater furnace 23 are conducted to holding oven 25 by duct 26, blended with air introduced by way of stack 27 under the suction of a blower 28 to achieve the desired oven temperature and distributed the length of the oven by duct 29. The operation of damper 30 and damper control arm 31 which regulates the quantity of air introduced by inlet stack 27 and the quantity of flue gas exhausted by exhaust stack 32 is controlled by an iron-constantine thermocouple positioned within the oven and connected to an indicating potentiometer controller. As thermocouple controllers are well known in the art, it is believed unnecessary to describe said controller herein.

Referring now to Figures 4 and 5, the pipe leaving preheater 23 enters oven 25 by way of inlet 40 formed in front wall 33 of the oven which is axially aligned with the outlet of said preheater. Immediately prior to entering inlet 40, the forward end of the pipe depresses an upwardly biased, normally open limit switch 41 which controls the operation of kickers 42 equidistantly mounted on shaft 43 for pivotal movement thereon. Shaft 43, which extends substantially the length of the oven 25, is journalled for rotational movement below the oven floor 34; kickers 42 being adapted to extend upwardly through openings 35 in the floor for pivotal movement therethrough. A double-acting pneumatic cylinder 36 connected by means of a pitman and crank assembly 37 to shaft 43 below oven floor 34 is adapted to retract kickers 42 into

a pipe receiving position when limit switch 41 is opened and to pivot one end of kickers 42 upwardly when limit switch 41 is closed. Therefore, upon depression of switch 41 by a pipe entering the oven, the kickers 42 are retracted into a pipe receiving position. Each pipe is conveyed into the oven by 38-cm. diameter concave rollers 45 seated in floor openings 45*a* and carried by shafts 37*a* which are connected by chains 44 to drive motor 46 and gear reducer 46*a* for rotation thereby. The pipe is thus conveyed into the oven by means of rollers 45 until the rearward end of the pipe clears limit switch 41 permitting the switch to be biased upwardly into its closed position to actuate kickers 42. Kickers 42 in pivotting upwardly through floor openings 35 raise the pipe from rollers 45 and roll the pipe onto transverse gravity feed rails 48 where the pipe travels partially across the oven onto a plurality of cross feed screws for continued controllable movement across the oven. Oven loading is preferably continued until the transverse gravity feed rails 48 are loaded with a single depth of pipe.

To neutralize any possible axial movement to the pipe as it is conveyed across the oven on the transverse screws, each adjacent screw is rotated in the opposite direction. For example, as illustrated by Figure 5, screws 50, 51 and 52 can be rotated in clockwise direction and screws 53, 54 and 55 rotated on a counter-clockwise direction, thereby cancelling any axial movement of the pipe. The two groups of screws are reverse threaded with a 7.6 cm. pitch and rotated in opposite directions to convey the pipe evenly across the oven, the rearward end of the pipe being continuously positioned in the oven at a point 15 cm. from front wall 33. Each of screws 50 to 55 is mounted on shafts 47 which are journalled for rotation in side walls 49 of the oven. Screws 50 to 55 are seated in transverse openings 56 formed in the floor 34 of the oven such that the screws extend partly below the plane of the floor. Sprocket wheels 57 secured to the exterior projecting ends of shafts 47 are rotated by chains 57*a* which are driven by a prime mover, not shown.

A plurality of pipe stops 58 co-extensive with a limit switch 59 are adapted to arrest the transverse movement of each pipe as it reaches the opposite side of the oven. Limit switch 59 is actuated by abutment of the pipe to de-energize the motor which drives cross feed screws 50—55 to prevent jamming of the pipe.

The retention time required to convey the pipe into, across, and out of the oven, preferably 15 minutes, has been found sufficient for heating the pipe to the oven temperature. The mixture of hot flue gas from preheater furnace 23 and air blended therewith to attain the desired holding oven temperature is introduced into the oven at points along the roof of the oven by duct 29 and escapes from the oven by way of the plurality of openings formed in oven floor 34.

The length of pipe abutting stops 58 on cross screws 50—55 is positioned for lifting by kickers 60 onto 38 cm. concave rollers 61 which are journalled for rotation below oven floor 34 and extend upwardly through floor openings 67. The rollers 61 driven by chains 62 operatively connected to clutch and gear reducer assembly 63 and motor 64 convey the pipe out of the oven through exit opening 65. Kickers 60, actuated by a pneumatic cylinder and crank arrangement of the type as described hereinabove with reference to kickers 42, are controlled by a limit switch 66 which is normally biased in an upwardly closed position. The pipe while exiting from the oven 25 through opening 65 engages switch 66 retracting kickers 60. As soon as the exiting pipe clears switch 66, the switch is biased upwardly into its closed position actuating kickers 60 which lift the next pipe onto rollers 61 for discharge from the oven. As limit switch 59 is released by removal of the abutting pipe, the cross screw motor means are energized actuating the cross screws which advance the next pipe carried thereon to abut stops 58 and open switch 59.

As the pipe length heated to the oven temperature is positioned on the oven outlet rollers 61, the clutch controlling the speed of gear reducer 63 is manually engaged to axially drive the pipe out of the oven at a speed approximately 1.2 metres per minute faster than the standard line speed. As the length of pipe exits through opening 65 of oven 25, its forward end is brought into contact with a coupler 70 which is axially aligned with opening 65. Coupler 70 is seated in trough 71 formed by inclined ramp 72 on one side, base 73 below and vertical wall 74 on the opposite side as most clearly illustrated by Figure 6. The upset portion 75 of coupler 70 is preferably of substantially the same diameter as the pipe exiting from oven 25 for axial alignment of the coupler with the pipe and the coupler ends 76 and 77 of reduced diameter are adapted to loosely fit within the bore 78 of pipe identified by numeral 79 for illustration such that as pipe 79 is conveyed thereby it automatically engages coupler 70 in axial juxtaposition to convey said coupler therewith. Side wall 74 of trough 71 is adjustably mounted on base 73 by means well known such that the dimensions of the trough can be varied to suit the pipe and pipe coupler diameters.

A pair of adjustably mounted press rollers 81 adapted to co-act with driver rollers 82 and a pipe passing therebetween, identified for purposes of illustration by numeral 83, are positioned between coupler trough 71 and coating head 100 to engage pipe 83 travelling ahead of pipe 79 in order to positively slow

its lineal speed such that the forward end 77 of coupler 70 carried by pipe 79 is driven into the rearward end of the pipe 83 to effectively couple the pipes together. It will be evident that several lengths of pipe can be coupled together at one time, the maximum length of continuous pipe being determined by the length of the oven 25.

In operation, one of the plurality of couplers 86 stacked above coupler 70 on inclined ramp 72 drops by gravity into trough 71 between the pipes passing thereby for automatically coupling the pipes together. In that it may be desirable to shield the pipe ends as they are fed through the coating device, the use of the embodiment of pipe coupler illustrated by Figure 7 may be preferred. A sleeve 87 secured to upset portion 88 of coupler 89 forms an annular space 90 which is adapted to loosely receive the ends of adjacent pipes and shield same ends from the coating material to be applied in the next stage to be described hereinbelow.

Immediately after the coupling is completed between the outgoing pipe 79 and the preceding pipe 83 which is in the process of being coated, the forward end of outgoing pipe 79 enters the press roll drive 80 formed by rollers 81 and 82 and simultaneously, the drive clutch controlling the rotation of the outgoing oven conveyor rollers 61 is manually disengaged. Formerly driven rollers 61 now become idler rollers and the length of pipe is drawn out of the oven by the press roll drive 80 and passed through the coating head 100 at the coating line speed as will be described with reference to Figures 8 to 11. The disengagement of rollers 61 from their power supply prevents knurling and cutting of pipe by said rollers after the pipe coupling step is completed and the pipe lineal travel slowed.

After being slowed in press roller 80 to the desired lineal speed, the hot pipe at the desired coating temperature is cantilevered through coating head 100 wherein a resin in a dispersed particulate form is brought into contact with the pipe surface, adheres, melts and flows to coalesce as a uniform and continuous coating. In coating the pipe with epoxy resin, an average thickness of 25 microns provides satisfactory corrosion resistance. A pipe surface temperature of 212° C. is desirable for optimum coating efficiency within the coating head to fuse the powdered epoxy resin into a continuous, pinhole free coating. In the use of polyethylene resin, an average thickness of 76 microns provides satisfactory results with the use of a discrete powder in the 75 to 300 micron size range. A pipe surface temperature of 200° C. is desirable for coating pipe with this material to obtain optimum results. In the case of some polyesters it has been found desirable to have a pipe surface temperature of approximately 317° C. and coat to an average thickness of 25 to 30 microns.

Figure 8 illustrates schematically the flow of powdered resin from the storage hopper 101 to the coating head 100 and the re-cycle of surplus coating material. A variable speed auger 102 disposed at the base of hopper 101 regulates the feed coating material 103 contained within the hopper into the system via duct 105 which is located in the suction line 106 of blower 107.

The powdered material is thoroughly dispersed with a gaseous medium such as air by the turbulence within blower 107 and discharged by way of line 109. The particles in suspension in the size range of from 6 to 300 microns, depending on the resin used, exit from line 109 into manifold 110 where the flow is divided into six flexible conduits identified by numerals 111 to 116 inclusive. Tubes 111, 112 and 113 discharge radially into hollow cylinder 117 and feed tubes 114, 115 and 116 feed into hollow cylinder 121 located at opposite ends of coating head 100, both of which are in communication with central opening 119 as most clearly illustrated by Figures 10 and 11. Hollow cylinders 118 are disposed in hollow cylinders 117 and 121 to form the end walls of coating head 100.

Six radial outlets 120 equispaced about the periphery of central ring 123 are connected to flexible tubes 124 to 129 inclusive which are gathered together into two groups of three tubes by conduits 130 and 131. Conduit 130 is connected to the bottom of resin hopper 101 and conduit 131 is connected to a dust collector 132 for reasons which will be described hereinbelow. It will thus become apparent that the coating powder is fed under pressure to the coating head 100 at each end thereof by outer rings 117 and 121, circulated within cavity 119 in contact with the exterior surface of pipe 83 travelling therethrough, and the excess powder recovered for re-cycling by way of central ring 123 which is under a partial vacuum. By this arrangement, the powder flows within cavity 119 from each end to the center of the coating head 100 maintaining powder losses to the atmosphere at a minimum and facilitating coating of the pipe 83. By dividing the exhaust from the coating head into two halves and re-cycling only one-half, the second half being fed to a dust collector 132, the volume of re-cycle medium is maintained at a minimum facilitating the material balance control.

Figures 9 to 11 inclusive illustrate, in detail, the sectional configurations of the head; Figure 10 illustrating a longitudinal section through the coating head and Figure 11 illustrating the transverse sectional configuration of central ring 123. The dispersed powder carried by air in a suspensoid form is introduced radially under pressure into cavity 119 by tubes 111, 112 and 113 and tubes 114, 115 and 116 for contact of the powder with the heated surface of the pipe passing there-

through and adherence thereto. The surplus powder is recovered at low-pressure outlets 120 which are connected to tubes 124 through 129 of ring 123 and re-cycled in the system or collected in dust collector 132.

Coating head 100 is supported within frame 133 by vertical support members 135 and 136 which are connected to the ends of the coating head as illustrated. The upper extremities of members 135 and 136 are connected to a horizontal cylindrical rod 137 which is mounted, in turn, on a pair of rigid horizontal members 138 and 139 which are slidably mounted at one end on post members 140 and 141 by sleeves 143 having lock screws 134 and joined and mounted at the opposite end to tension spring 142 connected to horizontal member 143. By raising and lowering members 138 and 139 on posts 140 and 141 and locking said members by lock screws 134a, the coating head can be vertically adjusted as desired.

Four diametrically opposed guide rollers, identified by numerals 148 to 151 inclusive, are adjustably mounted at the entrance to coating head 100 for axially aligning the pipe with the coating head. Each of said rollers is rotatably mounted on a base member 152 which is adapted to slide in radial groove 153 such that rotation of plate 154 having slots 155 of decreasing radius adapted to receive a projection 156 of each base member 152 adjusts the gap between each pair of opposed rollers to conform to the diameter of pipe passing therebetween.

After receiving a coating of synthetic resin, the pipes, joined by the pipe couplers 70, pass through the cooling influence of air in travelling over an unsupported span of 7 metres and are then conveyed sequentially through a series of spray devices 160 to receive a coolant spray for secondary cooling. The quenching devices 160 illustrated generally by Figure 1, and in more detail by Figure 12, each comprises cylindrical tunnels 162 having a multiplicity of openings 163 formed on the inner side thereof for discharge of a coolant spray such as water onto the pipe passing therethrough. Rubber covered wheels 164 arranged in pairs, as illustrated, have been found satisfactory for conveying the hot coated pipe through the quenching devices.

The passage of the pipes through three water quenches has been found sufficient to cool the coated pipe so that it can be handled safely and tested by a 1000 volt imperfection detector 165, and marked for repairs if necessary. After passing through the detector 165 the leading pipe is accelerated on rollers such that it is pulled apart from the following pipe and is thus conveyed onto the storage racks 166.

The present invention possesses a number of important advantages. A coating of corrosion resistant synthetic resin can be applied to rod, pipe and the like tubular goods under closely supervised plant conditions by means of automatically and semi-automatically controlled equipment. The pipe can thus be coated in a controlled environment where it is protected from large temperature variations, dust, rain, snow, ice and the like variable conditions normally encountered in the field. Flaws in the coating can be readily detected and corrected immediately after the coating step, thus minimizing follow-up operations and maintenance.

The synthetic resins employed to coat the pipe have been found to be superior to pre-existing coating materials in that they provide improved dielectric or corrosion resistant properties in addition to continued resistance to moisture, acids, alkalies and heat and considerable adhesion strength, hardness, ductility, resilience, abrasion and impact resistance for protection of the pipe during handling and installation.

It will be understood, of course, that modifications can be made in the preferred embodiment of the invention described and illustrated herein without departing from the scope of the invention as defined by the appended claims.

WHAT WE CLAIM IS:—

1. A method of coating elongated metal goods with a resin, which method comprises the following steps:—

(a) Cleaning the surface to be coated,

(b) heating at least the surface to a temperature above the melting point of said resin,

(c) coupling said heated metal goods axially and cantilevering them through a coating zone,

(d) applying or impelling said resin in a dispersed form in said coating zone onto the heated surface of said metal goods such that said resin will adhere, melt and coalesce on the surface to form a continuous coating of resin,

(e) cooling said surface to a temperature below the melting point of said resin to convert the liquid resin coating into an impermeable and continuous coat bonded to said surface.

2. A method according to Claim 1 wherein said cleaning of said surface to be coated comprises the blasting of the exterior of said surface with an abrasive material to provide a primary cleaning of said surface and washing said surface with one or more cleaning fluids to provide a secondary cleaning of said surface.

3. A method according to Claim 1 or Claim 2 wherein said resin is applied in a dispersed form with a gaseous medium.

4. A method according to any of the preceding Claims wherein said coated surface is cooled by quenching said surface with a coolant.

5. A method according to any of the Claims 1—3 wherein said coated surface is cooled by,

firstly, passing said surface through an air gap and, secondly, passing said surface through a spray of coolant in a quenching tunnel.

6. A method according to any of the preceding Claims wherein said surface is heated by furnace means to a temperature above the melting point of said resin.

7. A method according to any of the Claims 1—5 wherein said surface is heated firstly, by furnace means and then by a holding oven to a temperature in the range of 200° C—317° C.

8. A method according to any of the preceding Claims wherein said metal goods and the like are automatically transported into, through and out of the heating means.

9. A method according to any of the preceding Claims wherein said surface is coated with resin to a thickness within the range of 25—76 microns.

10. A method according to any of the preceding Claims wherein the surface is coated with particulate resin, the particles of which have a diameter within the range of 6—300 microns.

11. Apparatus for realising the method according to any of the preceding Claims comprising means for cleaning the surface to be coated, means for heating at least said surface to a temperature above the melting point of said resin, means for coupling said metal goods and the like, means for applying said resin to said surface, and means for cooling said surface to a temperature below the melting point of said resin.

12. Apparatus according to Claim 11 wherein said heating means comprise a furnace for heating at least the surface of said goods, and a holding oven for heating said surface to a temperature within the range 200°C—317°C.

13. Apparatus according to Claim 11 or Claim 12 wherein said means for applying the resin to said surface comprises a coating head which supplies particulated resin, the particles of which have a diameter within the range 6—300 microns.

14. Apparatus according to any of the Claims 11 to 13 wherein said cooling means comprise an air gap and means for spraying a coolant onto said surface.

15. Apparatus according to any of the Claims 11 to 14 wherein means are provided for automatically transporting said metal goods and the like into through and out of said heating means, and wherein means are provided for transporting said goods through said air gap.

16. Apparatus as described herein with reference to the accompanying drawings.

17. A method as described herein with reference to the accompanying drawings.

Dated this 6th day of November 1963.
ERIC POTTER & CLARKSON,
Chartered Patent Agents,
Nottingham, London.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1965. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.

1009055 COMPLETE SPECIFICATION

7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

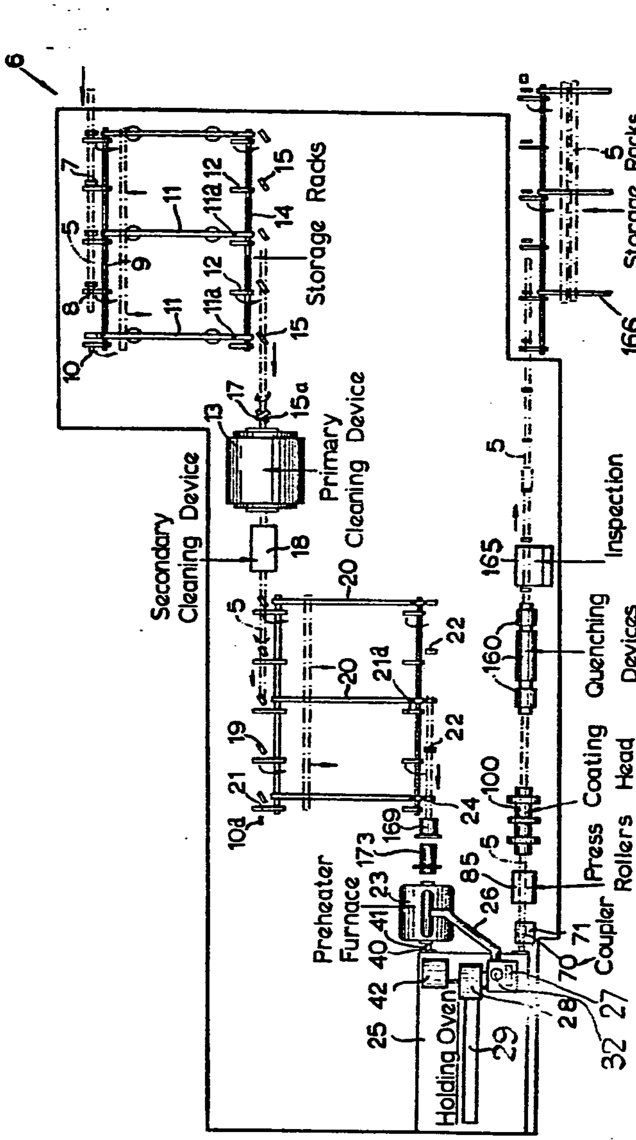


Fig.1

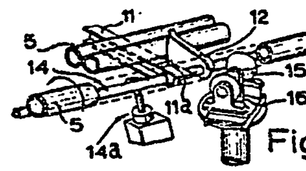


Fig.2

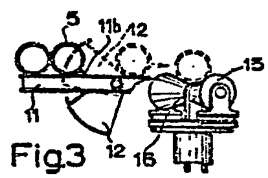


Fig.3

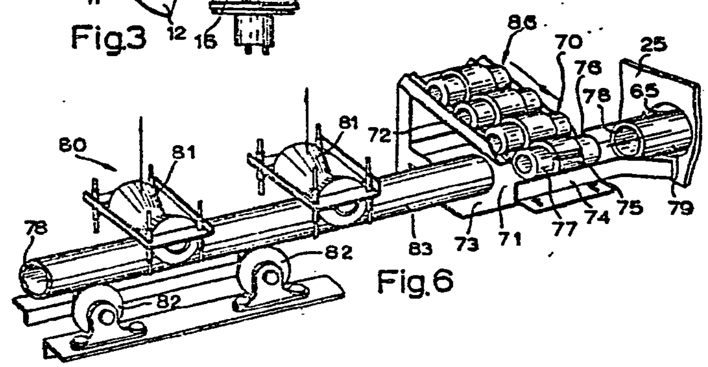


Fig.6

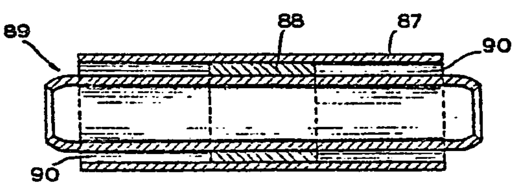
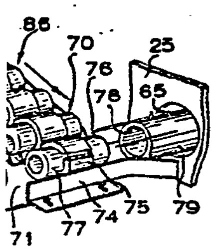


Fig.7

1009055 COMPLETE SPECIFICATION
7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 2 & 3

:2



.90

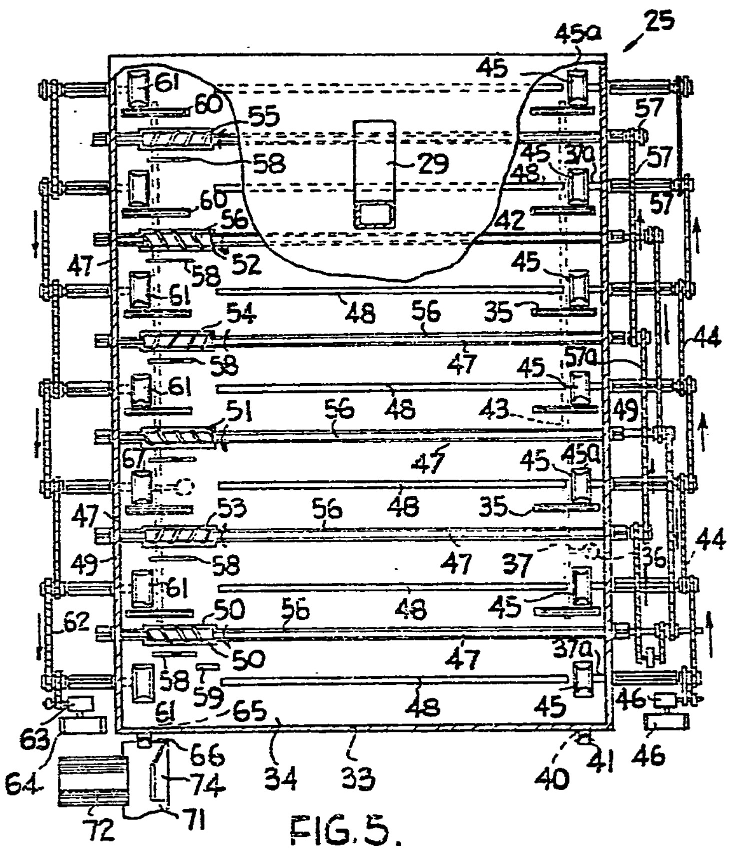


FIG. 5.

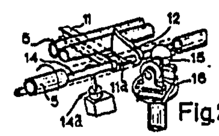


Fig.2

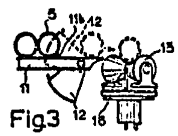


Fig.3

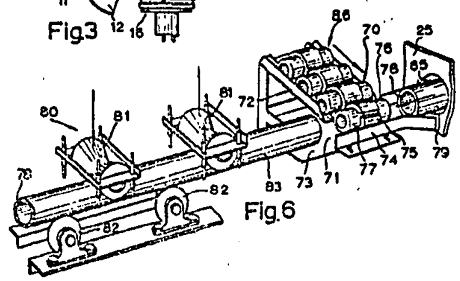


Fig.6

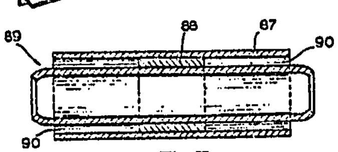


Fig.7

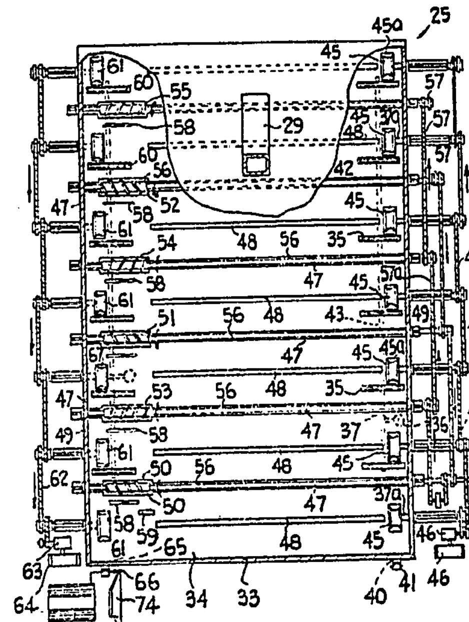
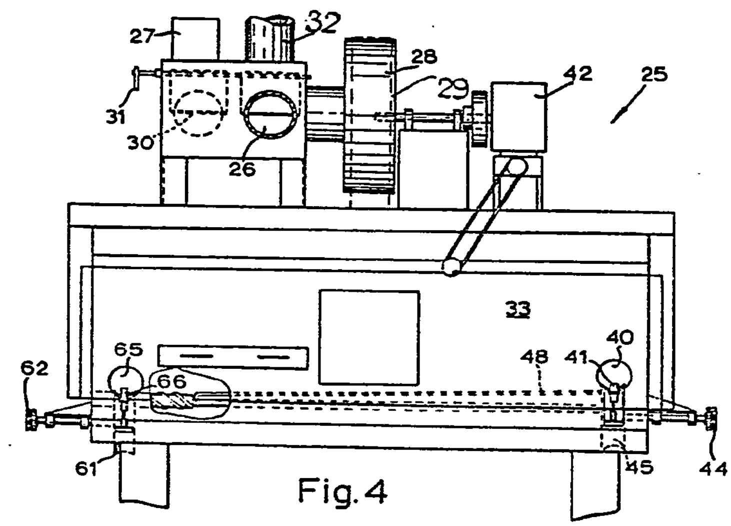
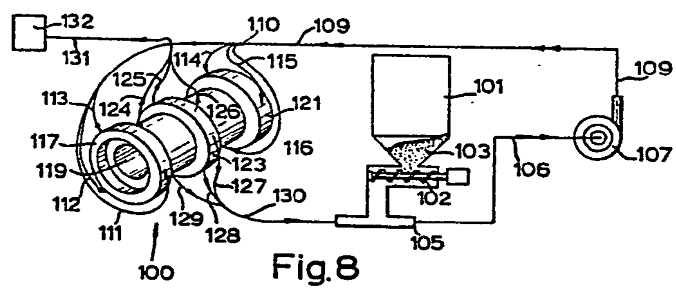
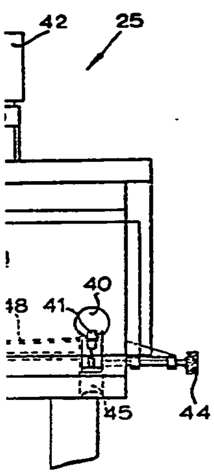


FIG.5.


27
32
28
29
42
25
31
30
26
33
65
66
48
41
40
62
61
45
44
Fig. 4


132
131
110
109
1147
115
125
113
124
126
121
101
117
123
116
103
119
127
102
130
112
129
128
111
106
107
109
105
100
Fig. 8


42
25
40
41
48
45
44

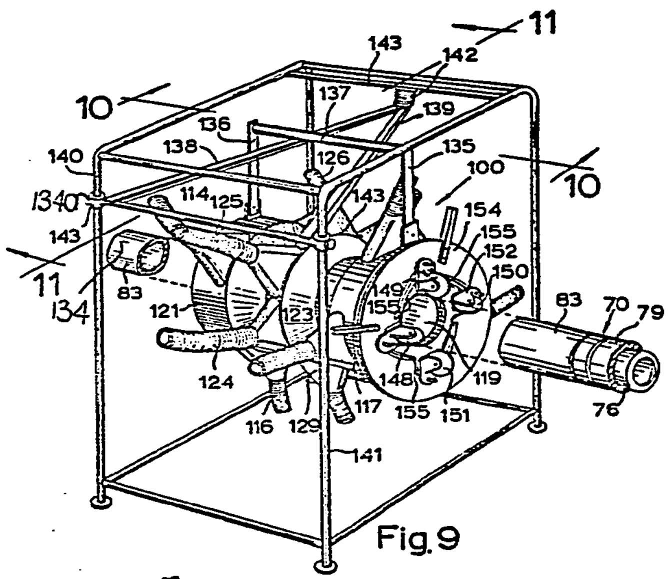
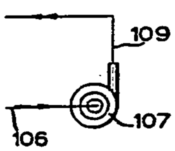

11
143
142
10
137
139
136
138
126
135
140
100
10
1340
114
125
143
154
143
155
152
150
11
134
83
149
155
83
70
79
121
123
124
148
119
155
151
116
129
117
141
76

Fig.9


109
107
106

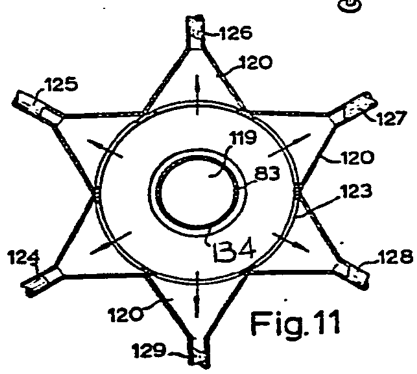

126
120
125
127
119
83
120
123
124
134
128
120
129

Fig.11

1009055 COMPLETE SPECIFICATION

7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 4 & 5

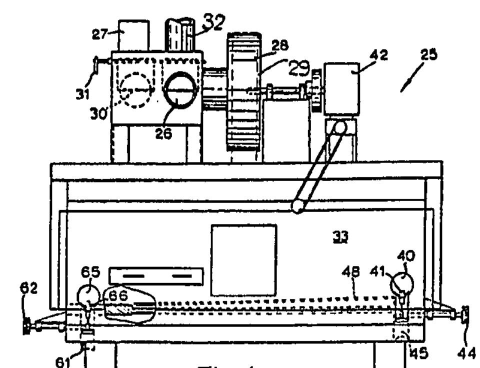


Fig. 4

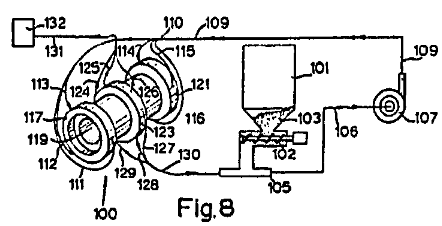


Fig. 8

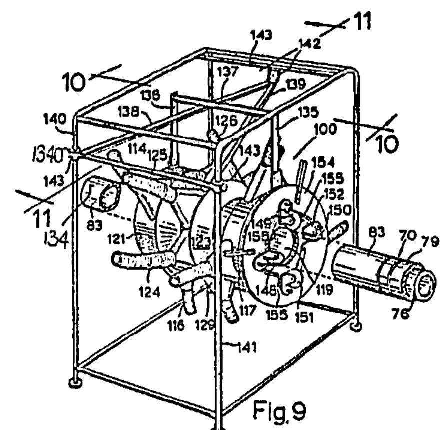


Fig. 9

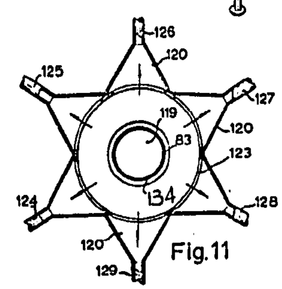


Fig. 11

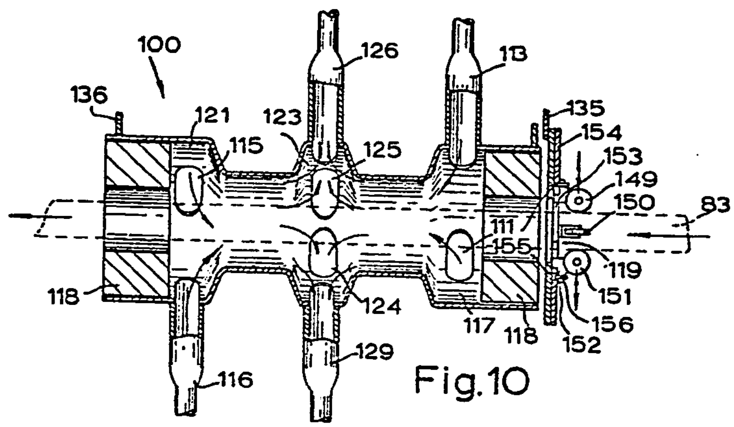

100
136
121
115
123
126
125
113
135
154
153
149
150
83
111
155
119
151
156
152
118
124
117
116
129

Fig.10

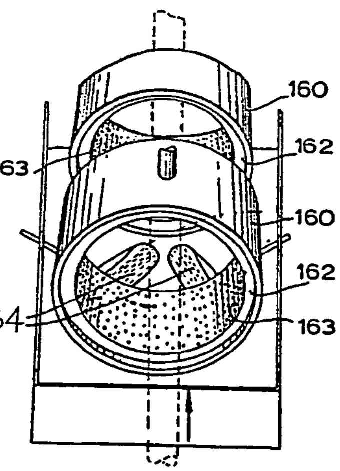

160
162
163
160
162
164
163

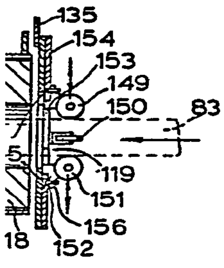
Fig.12

1009055 COMPLETE SPECIFICATION

7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 6 & 7

3



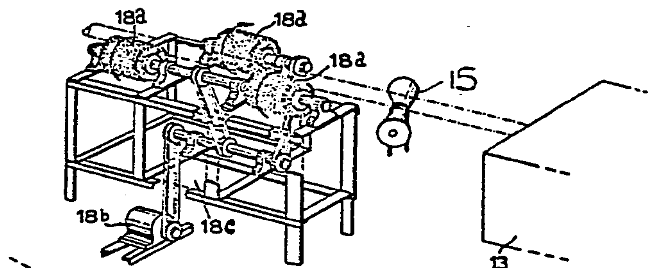


Fig. 13

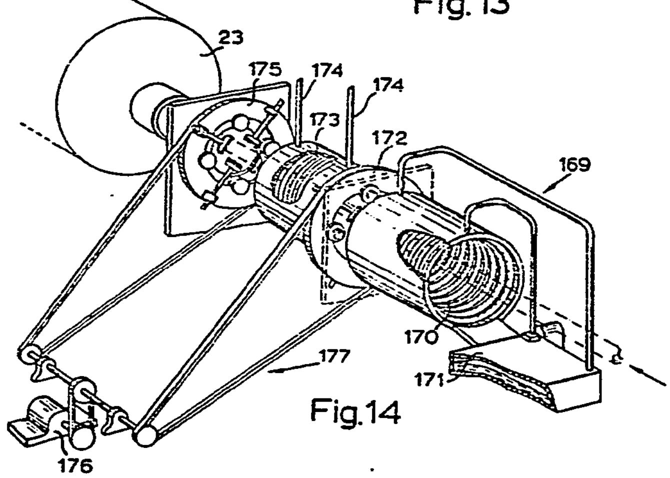


Fig. 14

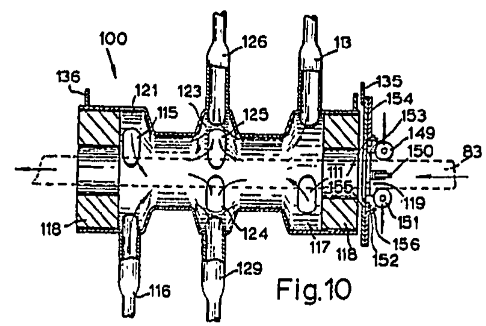


Fig.10

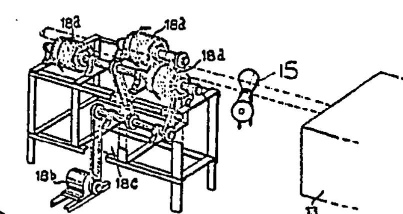


Fig.13

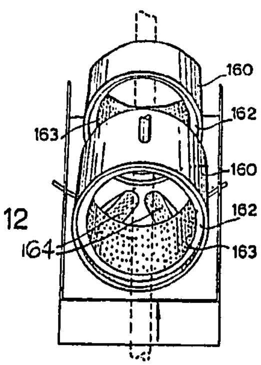


Fig.12

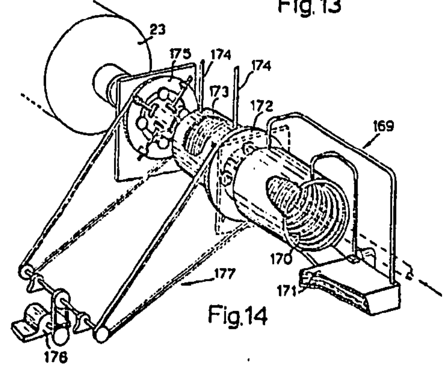


Fig.14